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The Impact of Pricing and Opportunistic Behavior on Information Systems Development

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Abstract:

Information systems development (ISD) takes place within an economical context. However, the economical conditions that shape ISD practice have hardly been researched. In this paper we study how pricing affects ISD in practice. Based on data collected in the Danish IT industry, we used a grounded theory approach to develop a model of the impact of pricing on ISD. The model was refined through the use of principal–agent theory and economic game theory in the form of the prisoner's dilemma. The model describes pricing structure, risk distribution, opportunistic behavior and their relationships as the elements that influence ISD practice. On this basis we argue for the uptake of new development approaches, such as agile software development (ASD), to improve ISD practice and its outcomes.

Keywords: Information systems development, pricing, principal–agent theory, prisoner's dilemma, pricing structure, risk distribution, opportunistic behavior, agile software development.

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INTRODUCTION

Information systems development (ISD) takes place within an economical context. Cost overruns are frequently reported, and the delivery of quality information systems within appropriate time and cost limits has even been given as one justification for the utilization of ISD methodologies (Avison and Fitzgerald 1995). However, the economical conditions that shape ISD practice are—beyond studies of IT service outsourcing (for an overview see, e.g., Lacity and Hirschheim 1993; Dibbern et al. 2004)—rarely researched by the information systems and the software engineering communities.

In the software engineering community, the term software economics has been coined (Boehm and Sullivan 2000). However, it mostly concentrates on questions related to effort estimation (see, e.g., Boehm 1981; Boehm et al. 1995; Jørgensen and Carelius 2004; Jørgensen et al. 2004; Jørgensen and Grimstad 2005).

In the information systems community, Ciborra (1996) takes a contractual view of ISD and based on transaction cost theory discusses concepts of market, bureaucracy and hierarchy, and clan with their differing levels of trust and task uncertainty as a basis for different forms of ISD approaches. A number of other IS-related studies (see, e.g., Banker and Kemerer 1992; Richmond et al. 1992; Whang 1992; Ang and Beath 1993; Richmond and Seidmann 1993; Wang et al. 1997; Banerjee and Duflo 2000) describe features of contracts, contract types, and pricing structures and investigate their economical role, but do not relate them to actual ISD practice.

Lichtenstein and McDonnell (2003) and Lichtenstein (2004) are exceptions and provide two such studies. They consider software development as outsourcing, and, based on an economical perspective, they formulate a number of hypotheses about the relationship among the frequency of milestones, project risk, uncertainty, and price structure as determined in ISD contracts, but they do not obtain any clear results.

Sabherwal (1999) and Bjerknes and Mathiassen (2000) discuss the antithetic relation between trust and control with regard to supplier–customer interactions and contracts. Based on this work, a case study carried out by Madsen and Kautz (2002) found that information systems development encounters difficulties when performed in an iterative way acknowledging uncertainty, but according to a fixed price contract. Against this background we formulated the following research question: How does pricing impact on information systems development in practice?

Based on data collected in the Danish IT industry, we used a grounded theory approach to develop a model of the impact of pricing on ISD. The model was refined through the use of principal–agent theory and economic game theory in the form of the prisoner's dilemma. The model describes the pricing structure, risk distribution, opportunistic behavior, and their relationships as the elements that influence ISD practice. On this basis we argue

CONTRIBUTION

Our study provides new insights into the mutual impact of pricing and opportunistic behavior on information systems development.

Based on the recognition that the established pricing structures that build on fixed price or time and material contracts have an embedded distribution of risk among the systems development organization, the supplier, and the customer, we found the following opportunistic behaviors: when the customers hold the risk, the suppliers might show opportunistic behavior in the form of a relaxed handling of deadlines and project steering, slippage and extension of the project scope, and in the form of the development of extra features, also called gold plating. The customers themselves might have an exaggerated focus on following up development activities and might show less acceptance of the developers' estimates and bills. When the suppliers hold the risk, the customers might behave opportunistically and refuse to provide material, personal, and business knowledge; they might care less about working toward agreed-upon deadlines and might try to enforce extra requirements. The suppliers themselves might try just to satisfy the minimum requirements, cut out some system functionality, freeze the system's scope, and agree to only minimum changes to the requirements. As a novelty in ISD research applying principle–agent theory and the prisoner's dilemma, these findings comprise a model of the impact of pricing and opportunistic behavior on ISD.

As a further contribution, these findings uncover the consequences of cooperation and opportunistic behavior in information systems development. While mutual cooperation might lead to mutual trust and the agreed earnings for the supplier and the agreed product quality for the customer, mutual opportunism might lead to mutual mistrust, low earnings, and inferior product quality. One-sided cooperation and opportunistic behavior might lead to either very large or very small earnings that are accompanied by inferior or superior product quality and a relationship characterized by some mistrust. Thus, as a final contribution, we argue for development approaches, contracts, and pricing structures that allow for the creation of trust. Such approaches, which are promoted under the label of agile software development, make operational features available to the customer at the end of each of several iterative delivery cycles and allow for the continuous evaluation of value and of the cooperation between customer and supplier.

for the uptake of new development approaches such as agile software development (ASD) to improve ISD practice and its outcomes.

The remainder of the paper is structured as follows: In the next section we present our research methodology. The following section describes our empirical findings, which build the basis for the grounded theory model. Then we introduce the two theories that we used to refine our model and explain and discuss the model itself. We finish by reflecting on the implications of our findings for academia and practice and provide some conclusions and research directions for the future.

RESEARCH METHODOLGY

The ontological and epistemological assumptions of the study are informed by the interpretive paradigm, and accordingly the role of those involved in the investigated phenomenon is understood as that of active constructors of meaning as well as active interpreters of reality. Their meaning construction process is central and forms the basis for understanding their actions. Drawing from symbolic interactionism (Blumer 1969), the meaning construction process is seen as occurring in social interaction between the actors involved in the investigated phenomenon. Moreover, the study adopts a social constructivist view of reality, implying that reality is socially constructed by the observer (Berger and Luckmann 1967).

The research approach of the study is inductive and based on a strong empirical foundation on which new theoretical insight into the impact of pricing on ISD practice is created. Specifically, the study uses an adapted version of grounded theory (Glaser and Strauss 1967) also referred to as constructivist grounded theory (Charmaz 2000). Its two processes, discovering and emerging, are understood as covering a meticulous interpretative process in which the resulting concepts, and eventually theory, are constructed. In other words, we do not seek the truth as universal and lasting, but we see the research product as a rendering of one interpretation among multiple interpretations of a shared or individual reality (Charmaz 2000).

Data Collection

The data collection was based on twelve semi-structured interviews with employees from seven companies, which were part of the Danish IT and software industry. The interviews were performed within a three-month period at the end of 2004. The number of interviews was limited due to resource restrictions, but as we could see a certain saturation of the data material during the later interviews, we do not consider this a disadvantage.

The interview partners were recruited through convenience sampling, as they were either members of the alumni association of the local business school or otherwise related to the professional network of the researcher. To counteract a possible bias, they represented diverse application areas and sectors such as aerospace, banking and finance, media and advertisement, health, and public administration and provided content management, document handling, e-business, process management, and many other kinds of information systems. They represented companies with as few as ten employees and as many as 50,000 employees. The companies were between six and forty+ years old.

As the project aimed at understanding the impact of pricing on ISD projects, we were interested in data from those stakeholders involved in the tasks spanning from the actual sales to the delivery of the final product. Thus, we interviewed two sales personnel, four project managers, and six developers across the different companies with three to 2-twenty-five years of experience in the field. The questions in the individual interviews were based on existing literature within the subject, and for this purpose we worked out interview guides for the individual interviews. As we worked with semi-structured interviews, the interview guide was used as a checklist for issues that had to be covered during the interview and not as an actual outline for the interviews. The nature of the interviews was open, and when the conversation moved toward new and interesting areas relevant to the subject, we pursued and probed the new directions. All the interviews lasted between sixty and seventy-five minutes and were tape recorded and transcribed. The interviewees had the opportunity to see and approve the transcripts. To appreciate the context of the investigation (Klein and Myers 1999), Table 1 contains a summary of the information about the participants in the investigation.

Data Analysis

The data analysis was conducted using a grounded theory approach. As grounded theory is used within different research traditions based on different epistemological assumptions, we find it important to emphasize how it was used in this study.

Table 1: The Investigation's Participants						
Respondent	Job Title	Experience/ Years	Tasks	Company	Age/Size	Customers/Products
1	Developer/ ERP consultant	8	Team leader/ Production of offers/ Business analyst/ Designer	A	30 years; 20000 employees globally; 30 in the investigated department	Enterprise systems for space, oil, energy, and trading industries
2	Developer/ ERP consultant	6	Systems analyst/ Programmer/ Organizational implementation			
3	Developer	3	Team leader/ Designer/ Programmer	B	20 years; 350 employees	Information systems for the health and defense sectors
4	Developer	6	Systems analyst/ Programmer/ Tester/ Organizational implementation			
5	Developer	8	Systems architect/ Programmer			
6	Developer	7	Systems analyst/ Programmer/ Tester/ Organizational implementation	C	20 years; 650 employees	Document handling, process systems, management systems, e-business, enterprise systems for the health sector and pharmaceutical industry
7	Project manager	15	General project management			
8	Project manager	6	Project administration including contract negotiation and monitoring			
9	Project manager	25	Project management for agile projects	D	40+ years; 50000 employees globally; 300 in the investigated unit	General IT and management systems—both bespoke and enterprise systems
10	Project manager	4	Project management for agile projects	E	6 years; 40 employees	Information systems for bank, finance, insurance, and transportation industries
11	Sales person/CEO	6	Project acquisition/ Customer care/ Contract negotiations/ Business analyst	F	6 years; 10 employees	Web-based information systems especially content management, e-business, marketing systems for trading, maritime, health, marketing, and media industries
12	Sales person	5	Project acquisition/ Customer care/ Contract negotiations/ Business analyst	G	20 years (5 years in Denmark); 14000 employees globally; 350 in the investigated unit	Information systems, especially resource and document management systems for the public sector, health care, banking, and insurance industries

Acknowledging the positivist leanings of the original authors (Glaser and Strauss 1967), we have used a later adoption of the theory by interpretive researchers, which stresses that theory does not emerge from data, but data are constructed from the many events observed, read about, or heard about (Strauss and Corbin 1998; Charmaz 2000; Locke 2001). The interpretation and recasting of the data in analytical and new terms involve the actors' as well as the researcher's interpretations (Strauss and Corbin 1998). From an interpretive perspective, the term emergence, therefore, covers a meticulous interpretative process, including the construction of concepts.

Based on our experience from earlier studies (Kautz et al. 2004; Kjærgaard and Kautz 2005) the analysis was conducted in a four-stage process. First, we named and compared incidents, identified concepts, and discovered their properties, similarly to what Strauss and Corbin (1998) refer to as open coding. Then we integrated the concepts and categories to build the first skeleton of a theory. Third, we reduced the number of categories, delimiting the theory, in order to identify the most relevant and robust categories to form a story. Finally, we presented the data and the results in the form of a narrative and a model for understanding the interrelationship of the different concepts that constitute the impact of pricing on ISD practice.

In line with the view of reality as socially constructed, we do not claim objectivity, but instead we argue that the emergent theory is one of several possible explanations of reality constructed with the researchers as active instruments. The theory or explanation reflects the viewers as well as the viewed. This does not mean that all explanations are equally relevant, credible, and acceptable, but that it is up to us as researchers to argue the case for the explanation that we want to present.

EMPIRICAL FINDINGS

The findings from the analysis are presented in the following subsections. First, the concepts and categories from the grounded theory analysis are introduced in more detail as they present the skeleton of our model of the impact of pricing on ISD. In the second subsection, first the theoretical frameworks, which contributed to the refinement of the analysis, are described. Subsequently, a stepwise movement through the resulting model will provide further insights from the analysis, as well as clarification of the relations between the model's constituting elements.

As a background for our further analysis, we identified the pricing structures our respondents used during the contract negotiations and realization of new ISD projects. In line with Overby et al. (2003) in their review of pricing structures, we found the following pricing structures in ISD practice: a fixed price comprises all the costs of a development project and the suppliers' profit depends on their ability to provide the desired system within time and budget. With its origin in a given task with a fixed scope, a fixed deadline, and a fixed price, a fixed price with payment for extra effort contains an explicit mechanism for dealing with changed or additional requirements. Time and material bills the actual effort, while time and material with an upper limit sets a threshold for the maximum expenses. Finally, we came across a fifth structure called *framework agreements.* Framework agreements comprise a maximum number of hours that a customer can book a supplier within a given time frame. This might give a customer a lower price per hour and gives both parties the liberty to negotiate the actual use of the hours according to all the available pricing structures.

The main concepts that we discovered and that emerged from the analysis are now presented as first empirical findings and as the basic building blocks for constructing a grounded theoretical model. We identified two main categories, namely, opportunistic behavior and risk distribution, which are both related to pricing and pricing structures and which are described below.

Opportunistic Behavior

Opportunistic behavior is the first major category that we discovered through our analysis. Opportunistic behavior can be found on the part of both the suppliers and the customers. However, the behavior is different depending on the underlying pricing scheme.

Suppliers' opportunistic behavior related to fixed price contracts

When the suppliers work under a fixed price contract, time pressure is often a consequence—as one developer put it: "I'll say time, whether you're able to stay within the time, that's the biggest challenge"—and, as a result, the suppliers might not be able to deliver the desired functionality. They then just try to satisfy the minimum requirements, and sometimes they choose to change the scope without the acceptance of the customer. Two developers admitted: "When you suddenly see that you have problems to deliver within the determined time frame you have two possibilities, you can change the scope or you can change the time frame" and "… if you are supposed to do it faster, you just have to cut out some of the functionality … and sometimes you just try to get as close as possible."

Suppliers also choose to deny customers the possibility of changing the requirements during the project or, by applying requirements management, try to minimize their amount and extent. A project manager reported, "One can very well keep oneself off the change of requirements and say, 'this does not concern us: we do what the requirements specification says.' As one can say, 'that's what you described and that's what you get,'" and continued, "In projects of a certain size you can see a whole office with people who do nothing else than requirements management. And every time the customer says a word, which hasn't been mentioned before, they'll say 'well, that will be expensive,' 'that's the first time you said that,' 'we have to estimate that,' and 'is there something you can do without them?'" As a consequence the customers might not obtain the systems they want, and they might choose another supplier in the future.

Suppliers' opportunistic behavior related to time and material contracts

When suppliers work under a time and material contract, they no longer have an incentive to steer a project strictly toward a hard deadline. According to a project manager, project management and project work become different, more relaxed tasks: "With time and material it is often the customer who provides a project leader; with a fixed price we always operate with one of our project managers," and he further commented: "The customer needs to put more effort in; it's them who need to follow up every week. They have to allocate time to keep track of the project. With time and material, we have all the time the customer wants."

Even when the suppliers are in situations in which they need personnel, material, or knowledge from the customer to solve a problem, their effort to obtain these resources is not that great: "With time and material we clearly give the customer a longer leash as compared to fixed price. After all it's them who pay when we are busy waiting," as one project manager put it. He also experienced more flexibility and fewer problems with changed deadlines, if the change is caused by circumstances for which the customers are responsible: "With time and material it is easier to push deadlines, as it's the customer who's paying the extra money."

Under time and material contracts, projects have a tendency to slide away from their original scope, which sometimes leads to an extension of the scope. One project manager reported that he has difficulties steering projects under these conditions. One developer confirmed this view. He expressed that his efforts are not specified and controlled in the same way as they are in projects where the supplier works under a fixed price contract. As a reason for the lesser control, he stated that a potentially inadequate effort has no direct economical consequences for the supplier company: "I have much freer hands from my company when it's not a fixed price, as we can't sit with any extra bills afterwards. We might get a problem, but we do not sit with any extra unpaid bills." Another developer stated that he tries new things to a greater extent in projects where the customer carries the risk, and he reported a concrete case in which he actually experimented together with the customer with new things that expanded the project's scope: "Some of the customer's folks could very well see that this was exciting and asked whether we just could try this and that … Yes, you can well say that there is a risk that one runs a little bit too fast and a little bit off the track to see the exciting things."

Under time and material contracts, developers have a larger tendency not just to be content with satisfying the customer's requirements, but to develop a system further single-handedly without their management's or the customer's acceptance. This phenomenon is called *gold plating* and all the interviewed developers justified their motivation with professional pride: "It should be as good as possible and there should not be any errors. And it should also be able to do this and that. And it would be smart if it even could do this and that. Sometimes it's the technology, which is interesting. One can also just do this, or just try that … " and "Sometimes you sit and just want to do it smart. You also want to do it properly. This was what they asked for, but if you do it just like that, it really will be good." However, beyond professional pride, extra payment for overtime work in the evening has also been mentioned as a reason for gold plating by one developer: "Yeah, well, then you might not be so effective during the day, because you know if you stay longer, your hours will count more and give you more money..... There is quite a bit of gold plating, I'll say. The folks feel that they really get something out of it, and then they'll easily find an excuse to do this or that."

On the other hand, gold plating is an example of an opportunistic behavior exhibited by suppliers which has an impact on the price of a project. It is often connected with projects that are run under time and material contracts. Although the developers do not keep to the requirements as described by the customer and develop extra functionality, the suppliers still try to obtain payment for that work by selling it as utility value. A developer said, "Because when you've got twenty hours for doing something and then the whole thing starts to slip, because you have been sitting and done some gold plating, it then gets hard to explain to the customer why the task took double the time," and a project leader expanded—when speaking about competitors at a customer—"… and so they go in to sell and in the course of the project they give the customer an understanding of the value of what they got and they hope that they do not have something against spitting in more money. However, the customer got very scared of this kind of behavior."

Customers' opportunistic behavior related to time and material contracts

Our respondents expressed that customers do show opportunistic behavior. Under time and material contracts, customers pay strong attention to how and for what a supplier uses the hours, and the suppliers need to put in extra time to provide the demanded evidence. As a developer put it, "The customer has a larger focus on what you are doing and they like to have an account of what you are using your time for. They make a much bigger fuss out of this in a time and material project than they do in a fixed price project."

Customers are also less willing to accept a price for a provided effort when billing is carried out according to time and material, especially without an agreed estimate. In such a situation it can be hard to collect the charges for some provided development work. A project leader reported, "When they pay for time and material, it is their right to ask for changes. But as with all customers it is much easier for them to ask for something than to look at the bill afterwards. So there easily can crop up a conflict if one does not steer a project sharply with estimates, but even then it happens."

Customers' opportunistic behavior related to fixed price contracts

Under fixed price contracts, some customers might not see any incentive to support the suppliers. Still, the suppliers' earnings depend on the customers' efforts in a number of areas. One of these is the provision of material and devices. One developer described his experience as follows: "I am supposed to be out at a customer's and there should be a computer for me so that I can carry out the project. When it's a fixed price project, it might very well be that the customer does not see the incentive to provide the device … especially in big and bureaucratic organizations you will experience that it can take time to get things organized … but if you are at a customer, who has got a bill before and the project is run with time and material, they'll take utter care that you get your screen to work at…."

Another challenge is to gain access to the right personnel. Developers often have the experience that those staff members they needed were also those on whom the organization was most dependent and who were not made available. However, a salesman also commented on the question of what he experiences as a problem: "I think that's user involvement … as the customers do not always see why they should spend money on it…." As a result suppliers insist on specifying the customers' efforts in the contract and—according to one developer—"that the customers provide competent people, because when they then don't do that, one can go in and say, that's what we have a contract about."

The limited access to competent personnel has to be seen in a wider context. Often customers consider the requirements specification as a complete description of the desired system and are not willing to provide further business knowledge. One developer summarized his experience as "Requirements specifications can be a help, so that we understand each other right, but when you put them instead of communication, so that's what will go wrong. And that's how it is. They'll say 'haven't we written down what we want to have; read it and do it' …" and concluded that this attitude and the limited contact with the customer is one reason why information systems do not live up to the customers' expectations.

Under fixed price contracts suppliers also experience that customers do not put in the effort that is oriented toward meeting a deadline, even if this would be sensible from a business perspective. The contributions and the productivity of the customers' employees do not live up to the agreements made between the two parties. A project leader reported, "Actually it should be extremely important for them to get the thing finished, will say from a business perspective to finish in time, much more than I have experienced it…." The respondents think that this might be related to the lack of a direct incentive for the employees or for the customers in general with regard to the particular projects where this occurs. To counteract this effect some suppliers specify the required customer effort in even more detail in their contracts.

Customers' opportunistic behavior in the form of lacking access to customer personnel and knowledge and lacking customer efforts—often under fixed-price contracts—increases the workload of the supplier. This comes in the form of a larger expenditure of hours to compensate for the customers' missing dedication. The extra hours that become necessary are often not included in the official project plan and the developers are forced to work overtime to be able to finish their tasks on time. A developer described the situation: "Well, the less time you have, the more you have to work every day so that you can reach the goals, which have been set; isn't it like that? So this means automatically longer working hours." Another developer had similar experiences from a project where a customer came up with new requirements late in the project. In this case the customer had provided the agreed effort, but the new requirements had not been taken into account in the original planning of the project. This increased the developers' workload as they were bound to a fixed deadline and "Yeah, well, so we simply worked more. So we put in these 45–55–60 hours per week, where we work until 10 or 11 P.M. in the night." This has consequences for the supplier, especially when it is not possible to demand a payment for the extra effort, as it usually necessitates

payment of the overtime to the company's developers. As one developer said, "We are so fortunate here that we get fixed wages and a payment for overtime, which we really get paid. So it costs the company when we work extra."

On the other hand—beyond the accepted general phenomenon that both suppliers and customers learn more about a system's potential during the course of a development project—when they are not carrying the risk, customers have a tendency late in a project to press extra requirements into the scope of the project that might lead to rework and extra resources. The dilemma for the project managers and developers is that denying the changes might have consequences for future cooperation with the customer, and accepting them leads to extra workload, time pressure, and shifting deadlines. The respondents think that the customer behavior is not necessarily based on a malicious exploitation of the situation. According to one project manager, it might be the missing experience that results in customers not being able to accept the relationship between the amount of requirement changes and the run time of a project: "But they have not tried this before; they have not tried that this is a kind of gentlemanly give-and-take game," and a developer confirmed, "If someone hasn't tried to be a customer before … many requirements first come toward the end of a project … and when they say they want to have this here, they do not have an understanding that this will take a longer time."

To prevent such situations, attuning expectations at the beginning of a project is important, especially with regard to the effort both parties expect each other to put into the project, and these expectations can then be part of the contract. One project leader shared his experiences in this respect: "So, there are some things that one should agree to settle in the start. If one gets a good balancing, one gets a good project.… Customers like it when one agrees on things up front; they hate it when one comes sweeping in afterwards … so in the plan, there are the things they should do and when I expect them to be ready, specified down to the week … and that is what they have to live up to; otherwise I can't hold my fixed price."

Risk Distribution

Risk distribution emerged as the second main category. Pricing and pricing structures embody a distribution of risk between the supplier and the customer. Using a fixed price as the pricing structure means that it is solely the supplier who carries and manages the risk. The pricing scheme, fixed price with payment for extra efforts, moves the part of the risk that deals with changes of the project scope toward the customer, because these are described and billed separately. The supplier carries the risk of the original project, while the customer carries the risk for the changes. The customer assumes the whole risk when a project is paid according to time and material. Every hour that suppliers disburse contributes to securing their earnings from a project. This means that the risk of delays, changes, and unexpected costs is carried by the customer. When time and material with an upper limit is applied, a part of the risk is pushed back to the supplier, as costs that are above the determined limit are defrayed by the supplier. The supplier has guaranteed the customer a maximum expense, but is willing to let the customer have the savings in case the project is finished before the maximum budget has been exceeded.

Both time and material with a limit and fixed price with payment for extra efforts are hybrids of fixed price and time and material. For them the exact distribution of risk between the supplier and customer is hard to determine. However, the tendency is clear. The more a pricing structure resembles a fixed price, the more risk has to be carried by the supplier, and the more the structure resembles time and material, the more risk has to be carried by the customer. A project manager and a salesman expressed this clearly: "Time and material ... the customer's risk. Fixed price … my risk. It's just that simple," and "It's quite obvious who's carrying the risk….. With a fixed price it's us and with time and material it's the customer."

Framework agreements differ from the others, as the contract does not specify any task and any kind of billing. The risk is on the customers' side, as they have paid for some work before it is delivered. When a concrete project is performed under a framework agreement, the risk can be pushed toward the supplier again, depending on the actual pricing structure used. Our respondents, however, did not go into further detail with regard to framework agreements. Therefore, in the remainder of our deliberations, they will not be discussed any further.

When suppliers work under a pricing model, which induces an element of risk for them, they compute a risk premium, which they add to the project's price. The same project leader said, "When we give a fixed price, we always add another 10–15 percent as contingency to cover unexpected costs, and then the customer gets the account as fixed price. That's how we do it. If there is a high uncertainty, we even put in a higher contingency for that respective task, which can be up to 25 percent." The risk supplement rises corresponding to the risk. Another project manager stated that there is a natural limit for how great a risk suppliers are willing to take. If a project is too risky, they reject fixed price as an acceptable model.

According to the suppliers the customers' perception of the distribution of risk has an influence on their demands for the price structure of future projects with a given supplier. At the beginning of a cooperation between a supplier and

a customer, both parties are uncertain about each other's capabilities to render an effort that lives up to the mutual expectations of a good cooperation. There is also uncertainty regarding whether the other party's intensions are honest and trustworthy. New customers are quite reluctant with regard to taking on risk and in general prefer a fixed price contract. One developer said, "As a rule there is not really a choice between the two pricing structures, because the customer typically demands a fixed price project," and another confirmed, "It's nearly always the customer who demands a fixed price." One project leader provided the explanation that the customers are uncertain whether they can rely on the suppliers' estimates and that there is no basis for trust in these earlier stages of the first contract negotiations due to a lack of familiarity with each other. The customers might be afraid of being burdened with further costs after the end of the negotiations. He described the situation: "When we come to a new customer, the question always is 'will this run away?' So, what shall we answer: 'Listen, I am a quite honest person, it will cost this and this, as this is what is written there.'" All the respondents confirmed this initial mistrust and some gave examples of customers' earlier experiences where their trust was abused.

However, it is possible to sell time and material projects, especially when the supplier and the customer know each other and by virtue of their cooperation have built up trust in each other. This trust is built up through continuous cooperation over a longer period of time or through many projects. One salesman put it this way: "We have also time and material projects; it really depends on the customer. But typically these are customers we know," and another added: "The more projects we have performed, the better we know each other, the better we can also work in a less restricted setting."

With trust building between the parties, it becomes possible for the supplier to convince the customer to take larger parts of the risk, which allows them to cut down the risk supplement of the fixed price offers. This enables the supplier to deliver a system for a lower price and thus gives them a competitive advantage. As one salesman concluded, "Ultimately, it is about getting the price down so that we have a bigger chance to get the assignment."

Experience from previous cooperation can also lead to a situation where the customers dare to take the larger part of the risk in future projects; however, as stated above, earlier experience can also result in the opposite reaction, namely, that a customer only wants to work under conditions where the supplier carries the full risk in the form of a fixed price contract. The same salesman summarized this as: "If one once has been offered to do something on a time and material basis and has abused it, you'll not get this kind of contract another time."

THEORY BUILDING AND DISCUSSION

When the findings had been explored in some depth and the theory was taking shape, we returned to the literature to compare the findings and to look for relevant theoretical contributions to the further analysis and discussion of the data. Before introducing the grounded theoretical model, we, therefore, briefly present the two theories from which we have drawn in the construction of the model.

The Prisoner's Dilemma

The prisoner's dilemma is a behavioral theory that formalizes situations of mutual dependency, such as those of principals and agents and it is part of the economical game theory (Douma and Schreuder 2002). In a more general form the theory can be used to characterize cooperation and deviation from a contract, termed as opportunistic behavior, by two business partners, where cooperation of both parties is considered a win–win situation, cooperation of one party and deviation from the contract by the other one as a win–lose or lose–win situation, respectively, and a situation where both parties deviate from the contract as a lose–lose situation. Then the following four outcomes for each business partner can be distinguished: they can receive (1) a reward for solely acting opportunistically (RSO), (2) a reward for mutual cooperation (RMC), (3) a reward (punishment) for mutually acting opportunistically (RMO), and (4) a reward (punishment) for (the naivety of) solely cooperating (RSC). To be defined as a prisoner's dilemma the subsequent relationship among the four outcomes has to apply: RSO > RMC > RMO > RSC. This leads to the situation depicted in Table 2.

We have not found any studies that have been used to explain the impact of pricing on ISD practice. The prisoner's dilemma, however, has been used earlier in the area of ISD to discuss open source development where collective action is no longer considered a prisoner's dilemma because the developers do not regard their participation as costly. Von Hippel and von Krogh (2003) argue that developers freely contribute to the provision of a public good as they achieve private benefits from doing so because open source development as a game in which material pay-offs constitute a prisoner's dilemma is transformed into a game in which cooperation is an equilibrium outcome where both pecuniary and social motivations are taken into account. This is, however, a situation that is quite different from commercial ISD.

Table 2: The General Form of the Prisoner's Dilemma			
		Business Partner 1	
		Cooperation	Opportunistic Behavior (Deviation from Contract)
Business Partner 2	Co-operation	RMC, RMC *Win–Win*	RSC, RSO *Lose much–Win much*
	Opportunistic Behavior (Deviation from Contract)	RSO, RSC *Win much–Lose much*	RMO, RMO *Lose–Lose*

Principal-Agent Theory

With regard to the relationship between suppliers and customers, principal–agent theory provided a suitable background for our study. It describes how a principal, a customer, should build up an incentive structure, a pricing structure, or a scheme to achieve a desired behavior from an agent, a supplier. Principal–agent theory is based on the assumption that people do not always keep the contracts and the agreements they have made. Such behavior, which might lead to advantages at the expense of others, is called *opportunistic behavior* (Douma and Schreuder 2002). Opportunism has been discussed as a characteristic of ISD practice since the early 1990s; however, in the more general sense of taking advantage of development opportunities, which are created by new requirements or partial solutions (see, e.g., Guindon 1990; Visser 1990; Visser 1992; Visser 1994), by deviating from a prescribed methodology (Nandhakumar and Avision 1999), or as an element of amethodical systems development (Truex et al. 2000), but not in the sense of taking advantage at the expense of others. A characteristic of such opportunistic behavior is that only some people, and also only at some times, exhibit it. It is difficult, if not impossible, to distinguish honest from dishonest people before they actually show opportunistic behavior. Principal–agent theory deals with the avoidance of opportunistic behavior. In this context two concepts are important, namely, risk, in particular the possibility of loss, and here especially the suppliers' relationship to risk, and observability, in particular the customers' possibility to observe a supplier.

Within the ISD literature requirements and software development risks have been discussed extensively, and frameworks for risk management have been presented and successfully applied (see, e.g., Lyytinen et al. 1996; Lyytinen et al. 1998; Mathiassen et al. 2007), but they have not explicitly stressed the role of pricing and pricing structures.

Table 3: Opportunistic Behavior in ISD		
	Supplier's opportunistic behavior	Customer's opportunistic behavior
Time and material contracts	• Relaxed handling of deadlines and project steering • Slippage and expansion of scope • Gold plating	• Strong focus on follow-up • Less acceptance of bills and estimates
Fixed price contracts	• Satisfaction of minimum requirements • Cut out of functionality • Freezing of scope • Minimizing change of requirements	• No provision of material • No provision of personal • No provision of business • knowledge • Not working toward deadlines • Enforcing extra requirements

A Grounded Theoretical Model of Pricing and Opportunistic Behavior in ISD

The above analysis shows the mutual dependency of the suppliers and the customers. The empirical data and findings have uncovered various forms of opportunistic behavior. The prisoner's dilemma allows us now to reflect on their consequences, as well as on the consequences of a cooperation between the two parties in terms of win–lose, lose–win, lose–lose, and win–win situations. The win–lose and lose–lose situations are characterized by one or both parties thinking "me" and "them," while in a win–win situation both parties think "we" and "us," taking care of the mutual dependency and relationship, and working to achieve their shared objectives.

Under fixed price contracts, customers experience the fulfillment of minimum requirements and the clipping of functionality as well as the freezing of scope and limitation of requirement changes as opportunistic supplier behavior, in which they lose and the suppliers win. Under fixed price contracts the suppliers experience the customer behavior of no provision of material, no provision of personnel, and no provision of business knowledge, as well as not working toward deadlines and enforcing extra requirements as opportunistic behavior with a win for the customers and a loss for the suppliers.

Under time and material contracts, the customers see the suppliers' relaxed handling of deadlines and steering, slippage and expansion of scope, and gold plating as opportunistic behavior and as a win for the suppliers and a loss for themselves, while the suppliers see the customers' strong focus on follow-ups and the lesser acceptance of bills and estimates as opportunistic behavior and a lose–win situation for themselves. Table 3 summarizes these behaviors.

If none of the parties show opportunistic behavior, they will achieve a win–win situation; if they both show opportunistic behavior, they will end up in a lose–lose situation. This is described in more detail below.

The opportunistic behavior of both suppliers and customers can have a number of consequences. These are summarized in Table 4. Dependent on which of the parties shows opportunistic behavior, this can lead to an increase in costs and prices, changes in the product functionality, its scope, and ultimately its quality, or a reimbursed or non-reimbursed increase in the supplier's development expenses. Opportunistic behavior might also lead to mistrust between the parties. However, in cases where both parties observe the terms of earlier contracts, they are able to build up trust in each other and thereby create the possibility to cooperate under a less strict framework. Suppliers and customers experience a mutual dependency, which satisfies the conditions of the general model for the prisoner's dilemma. This means that the collective benefit will be highest when both parties cooperate to reach a win–win situation. In such a situation the customers will gain a product that satisfies their expectations and with the quality as agreed in the contract. Likewise, the suppliers will receive the earnings as agreed in the contract and both parties will develop trust in each other.

Table 4: The Consequences of Opportunistic Behavior and Cooperation in ISD

	Co-operation	Opportunistic behavior
Co-operation	Supplier: • Earnings as agreed in contract • Trust in customer Customer: • Product quality as agreed in contract • Trust in supplier	Supplier: • Minimization of earnings • Mistrust in customer Customer: • Maximization of product quality
Opportunistic behavior	Supplier: • Maximization of earnings Customer: • Minimization of product quality • Mistrust in supplier	Supplier: • Minimization of earnings • Mistrust in customer Customer: • Minimization of product quality • Mistrust in supplier

The relationship between suppliers and customers is, however, characterized by the temptation, which each party experiences, to think or work toward achieving a win–lose situation. In a case in which the suppliers work toward such a situation and the customers work toward a win–win situation, the suppliers will be able to maximize the earnings from the respective project. The profit will be of such a magnitude that the suppliers will earn more from the project by acting opportunistically than they would earn in a win–win situation for that one project. This happens at the expense of the customers, who either gain a product that does not meet their expectations or has less functionality and thus quality, or who have to pay more. In any case, the customers develop mistrust.

If, in contrast, the customers work for a win–lose situation and the suppliers for a win–win situation, the customers will experience the fulfillment of their expectations and the quality of the product. The maximization will be to such an extent that the customer will achieve a better system by acting opportunistically than by working for a win–win situation. This happens at the expense of the supplier, who will be forced to use more resources and thus will have a smaller profit for that respective project as agreed. It will, however, also lead to mistrust by the supplier for the customer.

Finally, when both parties act opportunistically, they end up in a lose–lose situation. Both parties will gain less than in a win–win situation. Beyond less profit for the suppliers, less product quality and fewer fulfilled expectations for the customer, both parties will also develop a mutual mistrust for each other.

The issue of trust and mistrust brings us back to our original research question: How does pricing impact on ISD in practice? Applying principal–agent theory, we recognize customers as principals and ISD organizations as supplying agents. With regard to pricing, pricing structures have an embedded distribution of risk between both the supplier and the customer. The choice of pricing structure has an impact on risk distribution—and price level. Fixed price contracts shift the risk to the supplier. If, in contrast, a time and material contract is used, the risk moves to the customer and the price level increases with risk supplements, which reflect the risks that the suppliers perceive.

The distribution of risk and the pricing structure have an impact on the opportunistic behavior that both suppliers and customers show. When suppliers carry the risk under a fixed price contract their opportunistic behavior is derived from the experienced time pressure they work under to reach a deadline. They might then try to fulfill the customers' requirements with as little functionality as possible and sometimes even leave out some of it. They might also insist on the requirements specification as originally developed and not accept any changes to the requirements after the contract has been signed. In any case, the supplier compromises the functionality of the product to be delivered, as well as the customer expectations and, as such, in many cases the system's expected quality.

When the customers carry the risk under a time and material contract, the suppliers' behavior is influenced by the fact that their earnings will be higher the more time they use for an assignment. Thus, project management sometimes relaxes with regard to keeping deadlines, and progress and the customers' effort are not steered and monitored to the same extent as if the suppliers themselves carried the risk. Suppliers also extend and let the scope of a project slip by experimenting with new functionality and even technology. Unauthorized further development and attempts for perfection, known as gold plating, happen more often. Ultimately, the customers might not receive the systems they want and, as a consequence, might choose another supplier in the future.

The customers' opportunistic behavior differs depending on which party is carrying the risk. When the suppliers hold the risk, their earnings depend on the customers' efforts. Suppliers, however, experience that the customers do not provide them with the material, the personnel, and the business knowledge they need. They also complain that the customers do not work dedicatedly toward agreed deadlines and that they try to press new requirements into the projects. This is a problem for them, because denying these demands might have an impact on future business with the customer, while accepting them results in extra hours, time pressure, and changes to deadlines.

When the customers themselves carry the risk, they tend to demand more documentation with regard to the hours that the suppliers spend on the project. This, in turn, leads to larger administrative expenses for the suppliers. Customers also show less acceptance of the suppliers' use of time, which sometimes results in reluctance to pay for the suppliers' efforts. In that situation it can be hard for the suppliers to collect the charges for some provided development work.

The behavior of the suppliers and customers in return has an impact on the distribution of the risk between the two parties and on the pricing and pricing structure for a project. As described above, lacking customer efforts might lead to an increased workload and economical strain in the form of less profit for the suppliers and relaxed project steering and handling of deadlines might cause more billable hours and increased profit and thus higher costs for the customer. The same is true for slippage and expansion of scope as well as for gold plating.

The customers' experiences from previous projects with regard to distribution of risk and price level have an impact on their choice of pricing structure for future projects. A basis for trust is created when suppliers live up to the customers' expectations, which means that the customers will be more willing to choose a pricing structure in which they carry more of the risk. However, when suppliers abuse this trust either by decreasing functionality or raising prices, mistrust develops and customers will not accept the same degree of risk in future projects. Figure 1 comprises a model of the mutual impact of pricing and opportunistic behavior on ISD in practice.

As principal–agent theory describes how a principal, the customer, should put together a reward structure, i.e., pricing structure, to achieve the desired behavior from an agent, the supplier, in this context observability of the suppliers' efforts plays an important role. The customers are usually not able to observe the suppliers' efforts directly and often realize that it is too expensive and unrealistic, e.g., as project leaders in severe technical projects, to observe the suppliers directly. Therefore, they leave the management of the projects to the suppliers and demand and choose to use signals as an indication of the actual effort. The suppliers meet the demand and experience the necessity to send these signals and give them in the form of project plans and follow-ups.

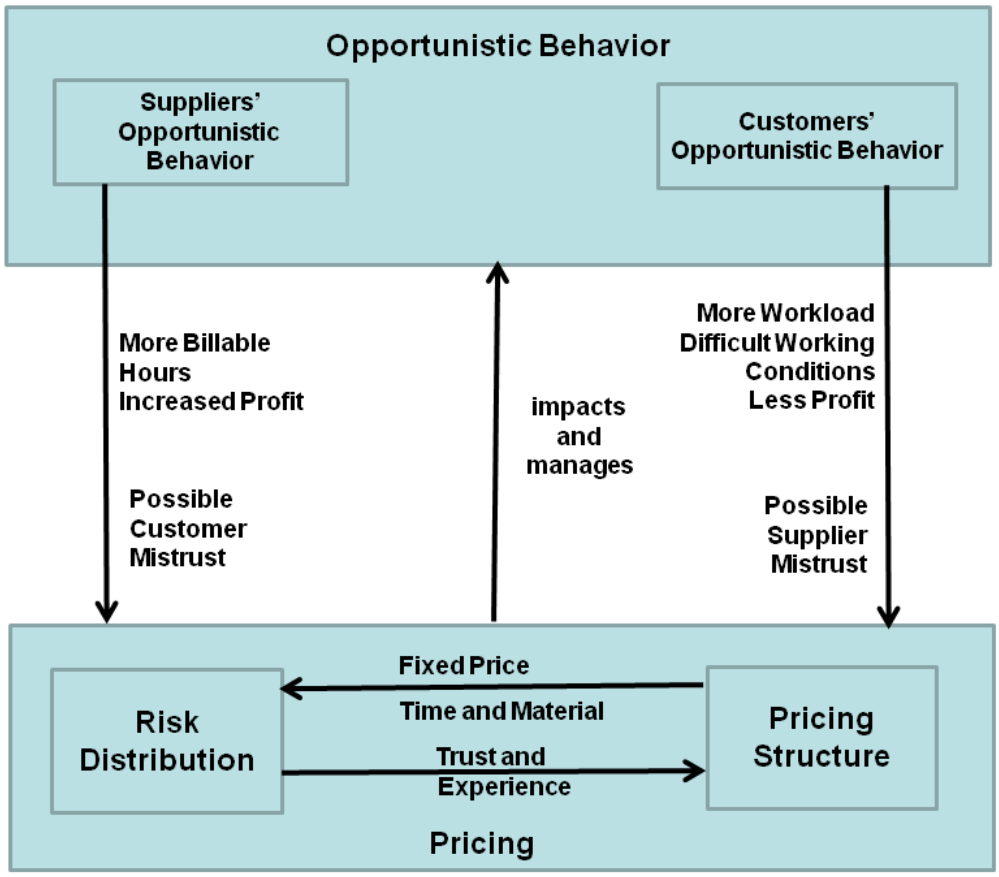

Figure 1: A model of the mutual impact of pricing and opportunistic behavior on ISD in practice

In order to give the supplier the biggest possible incentive to deliver an effective effort, customers are put in a situation where they can choose between shifting the risk over to the supplier in the form of demanding a fixed price contract or remunerating the supplier in accordance with the provided signals. The choice between these two possibilities is made on the basis of the extra costs that are implied by a shift of risk.

IMPLICATIONS AND CONCLUSIONS

Our analysis and model of the impact of pricing and opportunistic behavior on ISD practice show that suppliers and customers are mutually dependent on none of the parties showing opportunistic behavior to ensure that the suppliers' earnings and the customers' expectations concerning the system's functionality and ultimately quality turn into what was agreed upon in the contract. This has implications for research and practice.

By emphasizing the role of pricing and pricing structures in the distribution of economical risks and the related opportunistic behavior, our research contributes to the earlier work on requirement and software development risks and extends this body of knowledge by pointing to further possible risk resolution strategies.

In line with Bjerknes and Mathiassen (2000), who found that while trust promotes creativity and mutual learning, both necessary elements of ISD, and contracts promote decisions and monitoring of progress according to the agreement, we argue that to enhance practice it is necessary to reconsider the customer–supplier relationship and to change the current form of pricing structures and contracts. This argument is supported by Madsen and Kautz's (2002) case study, which indicates that iterative development with its explicit focus on learning is problematic when ISD has to be performed according to a fixed price contract. Ciborra (1996) has argued that if task uncertainty—as is often the case in information systems development—is high, the most efficient work arrangement is one based on a high level of trust. The question then arises regarding how to handle the contradiction between trust and control and how to develop trust.

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We agree with Highsmith (2002), who promotes as one way of creating trust what he calls "delivered-feature" contracts and pricing structures, where the supplier makes operational features available to the customer at the end of each iterative delivery cycle. Such contracts are based on the time and material pricing structure. They provide visibility and observability and allow for the continuous determination of value and of the contract, but they require a development approach and model that support short iterations as promoted more recently under the label agile software development (ASD) (Highsmith 2000; Cockburn 2002; Highsmith 2002), but already advocated for more than a decade and known as, e.g., evolutionary systems development (Budde et al. 1992).

Agile software development is feature-based, iterative, time-boxed, and risk-driven. Highsmith (2002) argues that instead of seeing changes as a problem, which has to be controlled by restrictive management strategies, ASD views changes as producing opportunities, which are pursued through risk entrepreneurship. Risk entrepreneurship evaluates risks continuously and critical risks drive the plans and the execution of iterative ISD, as already stated by Boehm (1988) when he introduced the spiral model for software development. In this context time boxes are not used to force staff into long hours or to decrease quality, but to focus and to bring about the decisions that are necessary to prioritize development work (Schuh 2005; Hazzan and Dubinsky 2007). The challenge remains to convince both suppliers and customers to apply such approaches. Our work, which demonstrates the impact of pricing on ISD practice, might provide an argument for the further uptake of agile software development.

The presented model contributes with a cumulative treatment of the interrelationship of pricing, pricing structure, risk distribution, and the opportunistic behavior of suppliers and customers in ISD practice. This provides a solid basis for future studies. As a novelty in ISD research, we have applied principle–agent theory and the prisoner's dilemma to refine our model.

We have limited our study to the development of new information systems and excluded operation, maintenance, and further development, as well as the development and adjustment of off-the-shelf products and have not researched whether there is any relationship between particular pricing structures and development models. These issues and the defendable limitation—as we were interested in their perspective in particular—that we only interviewed supplier and not customer organizations, should be considered when performing future investigations.

Our grounded theoretical model is also based on empirical data, which was provided by a limited number of informants. Now as the model is established it should be validated further in several ways, e.g., by performing some in-depth studies in selected cases and through a more comprehensive and broader survey. Such future studies should take all the above described limitations into account to provide a profound basis to both refine the model and to offer additional operational advice concerning pricing and contracts, risk distribution and opportunistic behavior to improve professional ISD practice.

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